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1995

EPA Superfund
Record of Decision:

DOVER AIR FORCE BASE
EPA ID: DE8570024010
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DOVER, DE
09/26/1995

Text:

RECORD OF DECISION
DECLARATION OF THE SELECTED INTERIM REMEDY

Site Name and Location

Target Area 1 of Area 6, West Management Unit, Dover Air Force Ba
County, Delaware.

Statement of Basis and Purpose

This Record of Decision (ROD) presents the selected interim remed
for Target Area 1, which was chosen in accordance with the requirements
Comprehensive Environmental Response, Compensation, and Liability Act of
(CERCLA), as amended by the Superfund Amendments and Reauthorization Act
1986 (SARA) and, to the extent practicable, the National Oil and Hazardo
Substances Pollution Contingency Plan (NCP), 40 CFR Part 300. This deci
prepared by the U.S. Air Force, the lead agency, as the owner/operator o
is based on the Administrative Record for the Site. Support was provide
Environmental Protection Agency (EPA) Region III and the Delaware Depart
of Natural Resources and Environmental Control (DNREC).

The State of Delaware and the U.S. Environmental Protection Agenc
with the selected interim remedy. The information supporting this inter
action decision is contained in the information repository for the Admin
Record located at the Dover Public Library, Dover, Delaware.

Assessment of the Site

Four regions were identified in Area 6 where shallow groundwater
combined concentrations of the chlorinated solvents trichloroethene, per
and 1,2-dichloroethene in excess of 1,000 æg/L. These regions were infe
the vicinity of the source areas for the chlorinated solvent plumes pres
and were incorporated into areas for remediation termed Target Areas. T
addresses the interim remedy for Target Area 1. The maximum concentrati
chlorinated volatile organic compounds in Target Area 1 groundwater was
æg/L. While a Risk Assessment was not performed specifically for Target Ar
risk associated with exposure to Area 6 groundwater under a hypothetical
commercial/industrial land use scenario was 9 x 10-4.

Actual or threatened releases of hazardous substances from this S
addressed by implementing the interim response action selected in this R
present a current or potential threat to public health, welfare, or the

Description of the Selected Interim Remedy

The selected interim remedy consists of in situ bioremediation of utilizing intrinsic bioremediation. Intrinsic bioremediation is one of the bioremediation technologies being applied to the Target Areas to promote development of alternate and innovative treatment technologies as encour CERCLA. Performance of the interim remedy and compliance with applicabl relevant and appropriate requirements will be evaluated in the Final Bas

Statutory Determinations

The selected interim remedial action satisfies the remedial selec requirements of CERCLA and the NCP. The selected interim remedy provide best balance of trade-offs among the nine criteria required to be evalua CERCLA. The selected interim action provides protection of human health environment, complies with federal and state requirements that are legal or relevant and appropriate to the action, and is cost effective. This utilizes permanent solutions and alternative treatment technology to the extent practicable, and satisfies the statutory preference for remedies treatment that reduces toxicity, mobility, or volume as a principal elem Force understands that although this interim remedy may not achieve MCLs certain contaminants, this interim action is only part of a total remedi Base that will be protective of the public health and welfare and of the when completed (CERCLA 121d, 42 U.S.C. 9621.d).

CHARLES T. ROBERTSON, JR. Date	THOMAS C. VOLTAGGIO Date
Lieutenant General, USAF	Hazardous Waste Management
Air Mobility Command	Division Director
Chairperson, Environmental	Environmental Protection Agengy
Protection Committee	Region III

Target Area 1

RECORD OF DECISION
FOR THE INTERIM REMEDY OF
TARGET AREA 1 OF AREA 6
WEST MANAGEMENT UNIT
DOVER AIR FORCE BASE, DOVER, DELAWARE

August 3, 1995

DECISION SUMMARY FOR THE RECORD OF DECISION
TARGET AREA 1 OF AREA 6
WEST MANAGEMENT UNIT
DOVER AIR FORCE BASE

INTRODUCTION

Dover Air Force Base (DAFB) recently completed a Focused Feasibili (FFS) conducted to address chlorinated solvent and pesticide source area contamination in Area 6 of Dover Air Force Base (DAFB), Delaware as an i response. The FFS was undertaken as part of the U.S. Air Force's Instal Restoration Program (IRP). The basis for the FFS was the Area 6 Remedia Investigation (RI) report dated July 1994, which characterized contamina evaluated potential risks to public health and the environment. The int performed as the first phase of Feasibility Studies to be conducted on s Management Unit, the management unit to which Area 6 belongs. The scope FFS was limited to the evaluation of alternatives for remediation of pri chlorinated solvent and pesticide source areas originating in the northe portion of the Area 6 region of investigation. The final remediation of if necessary, and non-source area contamination in Area 6 posing human h environmental risks will be addressed in the final Base-wide Feasibility

This Record of Decision (ROD) addresses Target Area 1, which is on chlorinated solvent source areas evaluated in the FFS. This ROD summari FFS, describes the remedial alternatives that were evaluated, identifies alternative selected by DAFB, and explains the reasons for this selectio Environmental Protection Agency (EPA) and the State of DeIaware concur w interim remedy selected in this ROD.

As an aid to the reader, a glossary of the technical terms used in provided at the end of the summary.

PUBLIC PARTICIPATION

The Proposed Plan for this site was issued on June 16, 1995. The comment period on the Plan was open through July 31, 1995. Documents co the Administrative Record for the site were available at the Dover Publi The only comments received during the public comment period were from th Remediation Technologies Development Forum expressing support for the pr interim remedy.

SITE BACKGROUND

DAFB is located in Kent County, Delaware, 3.5 miles southeast of t Dover (Figure 1) and is bounded to the southwest by the St. Jones River. comprises approximately 4,000 acres of land, including annexes, easement property (Figure 2). The surrounding area is primarily cropland and wet

DAFB began operation in December 1941. Since then, various milita have operated out of DAFB. The present host organization is the 436th A Its mission is to provide global airlift capability, including transport equipment, and relief supplies.

DAFB is the U.S. East Coast home terminal for the C-5 Galaxy aircr Base also serves as the joint services port mortuary, designed to accept the event of war. The C-5 Galaxy, a cargo transport plane, is the large the USAF, and DAFB is one of a few military bases at which hangars and r designed to accommodate these planes.

The portion of DAFB addressed in this ROD is located within Area 6 West Management Unit. The West Management Unit is one of four Managemen Units into which the Base has been divided (Figure 3). Area 6 is the la associated areas identified in the West Management Unit. The Area 6 reg investigation extends approximately 8,400 feet from its northern most po

hardstand and Building 723 to its southern most point near the St. Jones (Figure 4). The area north of U.S. Highway 113 contains the industriali

Target Area 1

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of the Area 6 region of investigation. The location addressed in this ROD this industrialized portion of Area 6.

DAFB is relatively flat, with elevations ranging from approximatel feet above mean sea level (MSL). The ground surface is covered almost e buildings, concrete, and asphalt. Surface water runoff throughout the i portion of Area 6 is controlled by an extensive storm drainage system. drains direct most runoff to either Pipe Elm Branch or the golf course t St. Jones River.

The Columbia Formation is the shallowest water-bearing unit and ho water table aquifer. The Columbia Formation typically consists of fine grained with varying amounts of silt, clay, and gravel. Discontinuous lens gravel silt and clay are also common. Generally, the upper portion of t Formation is finer grained and contains more silt and clay lenses than t portion. The water table is generally encountered at a depth of 10 to 1

ground surface (bgs) in the northern portion of Area 6 and shallows to w feet of the surface in the Base housing area near the St. Jones River. groundwater elevation or potentiometric surface of both the shallow and of the Columbia Aquifer range from approximately 13.5 feet MSL in the no portion to less than 3 feet MSL near the St. Jones River. The thickness Columbia Formation in Area 6 ranges from 28 to 64 feet.

Unconformably underlying the Columbia Formation is the upper unit Calvert Formation, which generally consists of gray to dark gray firm, d clay, with thin laminations of silt and fine sand. This upper silt and in thickness from 15 to 21 feet in the northem portion of Area 6. The h conductivity of this unit range from 6.83 x 10-3 to 1.53 x 19-3 ft/day (x 10-7 cm/sec), which are three to five orders of magnitude lower than t Columbia Formation. These significantly lower hydraulic conductivities to the vertical migration of constituents identified in the Columbia Aqu Underlying this confining unit is the upper sand unit of the Calvert For

Target Area 1

Frederica Aquifer. This aquifer averages 22 feet in thickness in the vi No constituents of concern were identified in the three Frederica monito installed in Area 6. Additionally, no production wells are installed th Aquifer in the vicinity of DAFB.

Area 6 is defined by the association of chlorinated solvents in gr forming a plume in the Columbia Aquifer. Several separate potential sou identified in the Area 6 RI that may have contributed to the chlorinated contamination. These potential sources include some of the twelve IRP s the Area 6 groundwater flow regime shown in Figure 4. Additionally, var and hangars where solvents are used may also be sources. The shop activ

solvent use is common include painting or paint stripping, aircraft and maintenance, and plating or welding. The northern most point of chlorin contamination is the aircraft maintenance area located north of Atlantic cholorinated solvent plumes extend approximately 4,600 feet south into B

The Area 6 RI identified four regions where shallow groundwater (i ten feet of the Columbia Aquifer) contained combined concentrations of t chlorinated solvents trichloroethene (TCE), perchloroethene (PCE), and 1 dichloroethene (DCE) in excess of 1,000 æg/L. These regions were inferr the vicinity of the source areas for the chlorinated solvent plumes that Area 6. The groundwater data suggested that primary source areas reside vicinity of the following reference points, which were incorporated into remediation tenned Target Areas:

Paint Washout Area (Site SS59) located along the eastern porti open storage yard. (Target Area 1)

Civil Engineering (CE) Shops Area including Building 607 (Carpent Shop), Buildings 608 and 609 (Material Control/Supply Offices) 615 (Interior and Exterior Electrical Shop, Power Production, and Sheet Metal Shop), and Building 650 (Sign Shop). (Target

Building 719 housing the Jet Engine Repair Shop. (Target Area

Target Area 1

Buildings 715 and 716 housing the ISO-Dock and an engine stora respectively. (Target Area 4)

The four Target Areas that have been identified are shown in Figur Target Area incorporates one of the primary suspected source areas and t significantly impacted portions of the shallow and deep groundwater plum with the respective source area. Plume maps of total chlorinated VOCs i

and deep groundwater are shown in Figures 6 and 7, respectively. The Ta are the regions of chlorinated solvent groundwater contamination that we in the FFS.

TARGET AREA/SOURCE AREA CHARACTERISTICS

The following section describes the physical and chemical characte Target Area 1, which is addressed in this Record of Decision.

Target Area 1 originates at the Paint Washout Area (Site SS59) and south approximately 800 feet between 8th and 9th Streets. Target Area 1 shaped and is approximately 5.2 acres in size. Target Area 1 adjoins Ta on its northern boundary. Expanded scale maps of the chlorinated solven residing in the shallow and deep portions of the aquifer within Target A shown in Figures 8 and 9, respectively. The maximum concentration of to chlorinated VOCs in Target Area 1 groundwater was found in the shallow C at a concentration of 16,042 æg/L in the presumed source location. Comp concentrations of chlorinated VOCs in the shallow and deep portions of t Aquifer, it is apparent that the constituents migrated downward through Aquifer where most of the plume expansion occurred.

SUMMARY OF SITE RISKS

The full Risk Assessment (RA) for Area 6 can be found in the final report dated July 1994. The purpose of the RA is to determine whether e site-related contaminants could adversely affect human health and the en The focus of the baseline RA is on the possible human health and environ

Target Area 1

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effects that could occur under current or potential future use condition that the contamination is not remediated. The risk is expressed as life cancer risk (LECR) for carcinogens, and hazard quotient (HQ) for noncarc example, an LECR of 1 x 10-6 represents one additional case of cancer in exposed population, whereas a hazard quotient above one presents a likel noncarcinogenic health effects in exposed populations.

The baseline RA focus on potential pathways by which maintenance a construction workers could be exposed to contaminated materials in Area exposure to groundwater and soil have been evaluated under a regular mai scenario; a future construction scenario; and a hypothetical future grou the Columbia Aquifer under a commercial/industrial scenario. Although a Area 1 RA has not been performed, the risk calculated in the Area 6 Reme Investigation from the hypothetical future exposure to groundwater withi LECR of 9 x 10-4, which exceeds the 1 x 10-4 to 1 x 10-6 risk range used need for remediation. In addition to the overall Area 6 risk, the Targe constituents of concern have been compared to the risk-based screening c (RBSCs) developed for the commercial/industrial scenario at DAFB to iden chlorinated solvents that present a risk-based concern.

The possibility exists for exposure of workers to hazardous substa

during excavation activities. Source areas identified during excavation protection as per health and safety protocols. All the workers performi at DAFB will be health and safety trained for work at CERCLA sites.

Based on the direction of groundwater flow, the Area 6 plume exten southerly direction towards the St. Jones River. There are no surface w points within Area 6 between the Target Area and the river. Presently, is confined within the Base property and has not reached the St. Jones R

The future use of groundwater from the Columbia Aquifer by Base pe quite unlikely and hypothetical. This hypothetical future groundwater u groundwater from the Columbia Aquifer will be used for drinking and show by Base personnel under a commercial/industrial scenario. The RBSCs wer

Target Area 1

with the maximum detected concentrations of chlorinated solvents in Targ (Table 1). Concentrations of seven of the eight detected chlorinated so dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene, perchloroethene, trichloroethane, trichloroethene, and vinyl chloride--in Target Area 1 e corresponding RBSCs in groundwater. The concentration of the other dete 1,1-dichlorethane, was bdow its RBSC.

Actual or threatened releases of hazardous substances from this Si addressed by the selected alternative or one of the other active measure present a current or potential threat to public health, welfare, or the

REMEDIAL ACTION OBJECTIVE

Within the groundwater in Target Area 1, the interim Remedial Acti (RAO) is to reduce the concentration of each ethyl-based chlorinated vol compound (VOC) by 90 percent. The ethyl-based chlorinated VOCs include 1,1-DCE, 1,2-DCE, vinyl chloride, 1,1,1-trichloroethane, 1,1-dichloroeth

dichloroethane. These VOCs are considered to be the most toxic and ther percent reduction interim RAO is applied to each of these compounds indi than to the aggregate concentration of all the chlorinated VOCs. For re consistency, the 90-percent reduction model was based upon the RCRA Post Permit (Reference No. DE8570024010, Permit No. HW05A05) for Site WP21 of which is a unit that adjoins Target Area 3 to the west.

The maximum concentrations of the detected chlorinated solvent com Target Area 1 are summarized in Table 2, along with the compound and Tar specific interim RAO. Table 2 also includes interim RAO concentrations compounds that have not yet been detected in the Target Area. These sel are chemical degradation products of some of the currently detected chlo constituents. Thus, reducing the concentration of detected compounds at producing other chlorinated VOC degradation products will not itself be satisfy the interim RAO. Note that if a ten-fold reduction from the max

Target Area 1

TABLE 1

Maximum Concentration Detected of Ethyl-Based Chlorinated Volatiles in Target Area 1, and Corresponding Risk-Based Screening Concentration

Target Area 1

Compound	Maximum Detected	RBSC
1,1-Dichloroethane	540	1,300
1,2-Dichloroethane	70	0.29
1,1-Dichloroethene	1,500	0.12
1,2-Dichloroethene	7,300	84

Perchloroethene	710	4
1,1,1-Trichloroethane	5,700	2,200
Trichloroethene	1,600	4
Vinyl chloride	180	0.058

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Concentrations reported in units of æg/L.
RBSC - Risk-Based Screening Concentration for Commercial/Industrial scenario Base. The RBSCs are based on a lifetime cancer risk of 1 x 10-6 or a whichever is lower.

Target Area 1

TABLE 2

Maximum Concentration Detected of Ethyl-Based Chlorinated Volatiles in Target Area 1 and Corresponding Compound and Target Area Specific Interim Remedial Action Objectives

Target Area 1

Compound	Maximum Detected	Interim RAO
1,1-Dichloroethane	540	54
1,2-Dichloroethane	70	7
1,1-Dichloroethene	1,500	150
1,2-Dichloroethene	7,300	730
Perchloroethene	710	71
1,1,1-Trichloroethane	5,700	570
Trichloroethene	1,600	160
Vinyl chloride	180	18

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Concentrations reported in units of æg/L.
RAO - Remedial Action Objective

concentration detected of a compound is below that compound's MCL, the M as the interim RAO.

The issues of final cleanup levds and attainment of ARARs will be the Final Basewide Record of Decision. The remedial action selected for part of the remedial action which will be selected in a Final Basewide R

SUMMARY OF ALTERNATIVES

Engineering technologies applicable to remediating the contaminate screened according to their effectiveness and implementability. Those t were determined to be most applicable were then developed into remedial The following remedial alternatives are numbered to correspond to the al described in the FFS report.

Alternative 1--No Action.

Alternative 2--Collection, Ex Situ Treatment, and Surface Wa Groundwater; and Performance of Soil Vapor Extraction in Chl Solvent Source Areas if Necessary.

Alternative 3--In Situ Groundwater Treatment Using Air Sparg Driven Convection Technologies Combined With Soil Vapor Extr

Alternative 4--In Situ Bioremediation of Groundwater Utilizi Bioremediation.

The four remedial alternatives that were evaluated in detail are d In addition, the capital, annual operation and maintenance (O&M), and pr of each alternative are provided.

Alternative 1

Capital Cost	$000
Annual O&M Cost	$000
Present Worth	$000

Target Area 1

The no action alternative is evaluated in order to establish a bas comparison against other alternatives. Under this alternative, no effor to reduce the groundwater concentrations of chlorinated solvents in Targ

Alternative 2

Target Area 1

Capital Cost	$170,000
Annual O&M Cost	$32,000(a)
Present Worth	$330,000(b)

(a)First year O&M cost. Refer to text
(b)Assumes 10 years of operation.

Alternative 2 consists of groundwater extraction, groundwater pret metals, groundwater treatment using air stripping for removal of chlorin carbon adsorption for removal of residual contaminants, and surface wate treated groundwater; performance of soil vapor extraction (SVE) in the s solvent source areas if determined to be necessary during remedial desig of the offgases from the air stripper and, if implemented, the SVE syste

A total of one extraction well is estimated to be installed in Tar estimating purposes only, to extract contaminated groundwater at a pumpi approximately 10 gallons per minute. If this alternative is ultimately interim response, then the exact number of wells and their placement wil during the remedial design. Extracted groundwater will be pretreated fo the concentrations of iron and manganese. Metals pretreatment reduces t

iron and manganese fouling subsequent treatment systems as well as ensur with surface water discharge standards for metals.

Pretreated groundwater will then be pumped to the top of a low pro air stripper that will transfer over 95 percent of the VOCs dissolved in to the air stream. The air stream containing the VOCs will then exit th where it will be treated using carbon adsorption prior to rdease to the

Target Area 1

Routine air sampling at a frequency determined during remedial design wi to ensure compliance with air emission standards.

Treated groundwater exiting the air stripper will be pumped to a l carbon adsorption unit to reduce the concentration of residual contamina comply with the surface water discharge standards prior to release to th tributary of the St. Jones River. Semi-annual water samples, assumed fo purposes only, will be collected to ensure compliance with discharge sta sampling frequency will be determined during the remedial design.

Vadose zone chlorinated solvent contamination is present in Target location where significant shallow groundwater contamination has been id address this potential source, performance of SVE in a limited sized are included with this area. A total of two SVE wells are estimated to be s remediate the source areas presumed to be present. Soil sources would b remediated in less than 2 years with SVE treatment; 2 years of operation costing purposes. If SVE is implemented, vapor collected by the SVE sys treated for organic constituents by vapor phase carbon units prior to be atmosphere. The necessity of performing SVE will be determined during t design.

Groundwater monitoring will be performed to monitor the progress o

remediation. In addition, existing land use restrictions associated wit operation of DAFB will be enforced throughout the course of remediation unauthorized extraction and use of the contaminated groundwater from the Aquifer.

The time required to achieve the interim RAO is estimated to be in to 10 years, provided no free phase solvents are present in the aquifer. solvents are present, the time required to achieve the interim RAO may b 30 years or more. The present worth cost of this alternative ($330,000) based on an assumed 10 year operation.

Target Area 1

Alternative 3

Target Area 1

Capital Cost	$440,000
Annual O&M Cost	$50,000(a)
Present Worth+	$730,000(b)

(a)First year O&M cost. Refer to text.
(b)Assumes 6 years of operation.

Alternative 3 consists of the in site treatment of groundwater usi of air sparging (AS) and density-driven convection (DDC) technologies, c SVE over the entire areas where in situ groundwater treatment is perform adsorption treatment of the offgases from the SVE system.

For in situ treatment at Target Area 1, 31 SVE wells and 28 AS/DDC estimated to be required for cost estimating purposes only. If this alt selected for this interim response, then the exact number of wells and t be determined during the remedial design. AS will be used in areas wher

premeable and free of clay. DDC will be used in areas where significant present. The SVE system operates in tandem with the AS/DDC system to ca contaminants stripped from the saturated zone. Vapor phase carbon adsor units will be used to remove extracted VOCs from the air stream prior t atmosphere. Entrained water will be separated by knockout pots and sent carbon adsorption units to reduce contaminant concentration to levels ac discharge.

Groundwater monitoring will be performed to moinitor the groundwat progress and plume migration. In addition, existing land use restrictio the military operation of DAFB will be enforced throughout the course of prevent unauthorized extraction and use of the contaminated groundwater Columbia Aquifer.

Target Area 1

The time required to achieve the interim RAO is estimated to be betwe 13 years, with 6 years being the estimate used for costing purposes. Th cost is estimated to be $730,000. The remediation time estimates are ba rate data from the AS/SVE pilot study performed at Site WP-21.

Alternatived 4

Target Area 1

Capital Cost	$000
Annual O&M Cost	$30,000(a)
Present Worth	$50,000(b)

(a)Groundwater monitoring cost expended by government in years 3 through 5 only.
(b)Net cost to government. Refer to text.

Alternative 4 consists of in situ bioremediation of groundwater uti

bioremediation in Target Area 1. Intrinsic bioremediation is one of the technologies being applied to the Target Areas to promote the developmen and innovative treatment technologies as encouraged under CERCLA.

The distribution of chlorinated solvent constituents in groundwate downgradient of Target Area 1 indicates that intrinsic bioremediation pr The degradation rates and reaction mechanisms associated with the intrin processes occurring in Target Area 1 will be studied over a multi-year p Remediation Technologies Development Forum (RTDF), which is a consortium from industry, government, and academia working to develop more effectiv costly remedial treatment technologies. Intrinsic bioremediation is a p technology; that is, it does not involve the installation of any extract physical/chemical treatment systems to effect the remediation of the aqu technology relies on the indigenous microorganisms to biologically degra contaminants. Although this technology is passive, it should not be con action alternative. Establishing the efficacy of intrinsic bioremediati extensive site characterization be made, which includes sampling, testin

evaluating microbial activity and biotransformation rates. The RTDF stu whether intrinsic bioremediation holds promise as a long-term remedy for present. Monitoring of the Target Area 1 groundwater plume will be cond estimated six monitoring wells for cost estimating purposes to allow the measurement of the intrinsic bioremediation processes. The monitoring p until the final FS and ROD is completed, which is estimated to be within 5 years for costing purposes.

The bioremediation process utilized is not expected to generate de

products that can migrate beyond the Base boundary. Groundwater monitor performed to monitor the groundwater remediation progress and downgradie quality to ensure that offbase plume migration does not occur. In addit use restrictions associated with the military operation of DAFB will be throughout the course of remediation to prevent unauthorized extraction contaminated groundwater from the Columbia Aquifer.

The time required to achieve the interim RAO will be evaluated dur study. It is anticipated that this interim remedy will remain active un is selected, which for costing purposes is estimated to be 5 years.

EVALUATION OF ALTERNATIVES

The selected alternative for remediating the contamination in the Alternative 4 (bioremediadon). Based on current information, this alter best balance of trade-offs among the alternatives with respect to the ni required to be evaluated under CERCLA. This section profiles the perfor selected alternative against the nine criteria and explains how it compa alternatives under consideration.

Overall Protection of Human Health and the Environment

The overall protectiveness criterion is a composite of other evalu especially short-term effectiveness, long-term effectiveness, and compli Alternatives 1, 2, 3, and 4 are all considered to be protective of human

period of implementation because of the existence of land use restrictio unauthorized extraction or use of contaminated groundwater in the Target preventing human exposure.

Alternative 1 (no action) is not considered effective because no p to monitor the Target Area plume to evaluate compliance with the interim

Alternatives 2 (pump and treat), 3 (air sparging), and 4 (bioremediation interim RAOs and are considered effective.

Compliance With ARARs

The interim RAOs that have been set for chlorinated solvent consti groundwater will allow for the resultant concentration of several of t exceed their federal Maximum Contaminant Levels (MCLs). MCLs, as provid CERCLA 121 (d)(2)(A)(ii), are relevant and appropriate requirements fo actions expected to be taken as a result of the Base-wide investigation.

Offsite contaminant migration, even for interim actions, requires other ARARs be considered. The principal ARARs that pertain to the offs of contaminants are the Delaware regulations implementing the Federal Cl Clean Water Act. These regulations are the Delaware Regulations Governi of Air Pollution (DRGCAP 1 through 3, 21 and 24), the Delaware Water Pol Control Regulations (DWPCR1 through 6), the Delaware Industrial Waste Ef Limitations (DWPCR 8), and the Delaware Surface Water Quality Standard (through 9, 11 and 12). The above referenced regulations regarding emiss organic compounds to the atmosphere will be complied with in Alternative ensure that acceptable levels of emissions are met. Alternative 2 will to surface water. The above referenced regulations regarding surface wa define limits of acceptable chemical concentrations for wastewater, and limits will be a requirement for this alternative. For Alternative 4, t migration or releases of contaminants. Alternatives 2 and 3 both meet a identified regulations that pertain to the offsite movement of contamina

Target Area 1

Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence criterion primarily con magnitude of residual risk that would remain after the implementation of and the adequacy and reliability of the controls instituted. All of the for the long-term protection of human health through the existing land u However, reliance upon land use restrictions is not considered a permane

Under Alternative 1 (no action), the chlorinated solvent contamina groundwater will not be monitored. Therefore, the adequacy and reliabil alternative cannot be established.

Alternatives 2 (pump and treat), 3 (air sparging), and 4 (bioremed result in significant reductions of chlorinated solvent concentrations i If any one of these treatment alternatives is selected, that system will interim RAO is achieved. Hence, no more than 10 percent of the maximum concentration of each ethyl-based chlorinated solvent will remain in the magnitude of residual contamination remaining in the Target Area is a fu the treatment alternative is operated or allowed to continue. Continued treatment system beyond the point at which the interim RAO is reached ma reductions in contaminant levels to be achieved. Performance of the int compliance with ARARs will be evaluated in the final Base-wide FS and RO

Reduction of Toxicity, Mobility, and Volume

No reduction of toxicity, mobility, or volume will be achieved by of Alternative 1. The three action alternatives include components whic significantly reducing the toxicity of groundwater in the Target Area.

The groundwater extraction system proposed under Alternative 2 wil hydraulic control over the plume, thereby limiting the mobility of conta the Target Area. The air sparging in situ treatment technology included operates by increasing the mobility of contaminants. This increased mob

in some spreading of contamination beyond the effective zones of these a the course of contaminant removal, however, the overall volume of the co be reduced. The bioremediation technology proposed under Alternative 4 impact on contaminant mobility. The toxicity profile of the groundwater somewhat during the biodegradation process, as vinyl chloride is generat degradation of the more chlorinated ethyl-based compounds. However, bec chloride has been detected in the groundwater thus far, the evidence sug chloride is rapidly detected to carbon dioxide, water, and chloride ion conditions found downgradient of the Target Areas.

Short-Term Effectiveness

Alternative 1 (no action) includes no remedial actions. Therefore short-term impacts on community or worker health or the environment from activities. However, because Alternative 1 will not monitor compliance RAOs established for this project, it is considered to be ineffective.

Alternatives 2 (pump and treat), 3 (air sparging), and 4 (bioremed be effective in reducing groundwater contaminant concentrations in the T None of these alternatives are expected to have significant impacts on w health or the environment. Alternative 2 is estimated to be capable of RAO within a 5 to 10 year time frame. However, although not believed pr pockets of DNAPLs in the aquifer could cause this time frame to increase more.

The presence of DNAPLs will also affect the length of time require interim RAO under Alternative 3, though to a lesser extent than will the Alternative 2. There are two reasons for this. First, there would be m sparging/density-driven convection wells under Alternative 3 than there extraction wells under Alternative 2. Thus, the chance of locating a re

a pocket of free product is much greater under Alternative 3. Secondly, remediation is a more aggressive remediation process than pump and treat transfer rates from water to air would be achieved with the physical in

Target Area 1

technologies lowering the concentration of solvents within the plume. L groundwater concentrations would increase the driving force for solubili product in order to maintain equilibrium. The time required to meet the under Alternative 3 is estimated to be between 4 and 13 years.

Alternative 4 is estimated to be capable of achieving the interim Area 1, though 50 years or more may be required. As with the other acti these time frames may be extended if DNAPLs are present. A DNAPL would continuing source of contaminants to the aquifer as the DNAPL constituen solubilized in the groundwater. This transfer of constituents from free phase would occur through the physical processes of desorption and liqui partitioning. These equilibrium-driven processes typically occur slowly relatively low surface area of DNAPL in contact with the groundwater in DNAPL volume. The solubilization rate of DNAPLs would likely be slower of degradation of the dissolved constituents. Thus, the solubilization likely be the rate-limiting step.

Implementability

Three main factors are considered under this criterion: technical administrative feasibility, and availability of services and materials. are administratively feasible and the required services and materials ar Hence, the comparison will focus on the technical feasibility of the alt

Alternative 1 (no action) and Alternative 4 (bioremediation) have

feasibility considerations. Alternatives 2 (pump and treat) and 3 (air technical feasibility concerns associated with them. These concerns are highly developed character of the Target Area and the numerous space con present. The Alternative 2 system includes only 5 groundwater extractio and a limited piping network. Alternative 3 consists of 59 air sparge, plus expansive piping and numerous treatment stations. Overall, Alterna to be the most easily implemented action alternative.

Target Area 1

Cost

No direct costs are associated with the implementation of Alternat nor with Alternative 4 (bioremediation). The capital cost of Alternativ treat) is $170,000 and the capital cost of Alternative 3 (air sparging)

The O&M cost of Alternative 2 will initially be $32,000 per year, $20,000 per year after 2 years of operation when SVE operations are disc O&M cost of Alternative 3 will be almost $50,000 tbe first year, but wil thousand dollars per year thereafter as the carbon consumption rate asso SVE system's offgas treatment units decreases. The O&M costs of Alterna approximately $30,000 per year for monitoring intrinsic bioremediation i However, the first 2 years of monitoring will be performed by the RTDF a intrinsic bioremediation pilot study at no cost to the government.

The present worth cost of the alternatives will depend upon the ti operated. The present worth costs of Alternative 2 under operating scen and 30 years are $270,000, $330,000, and $440,000, respectively. The pr costs of Alternative 3 under operating scenarios of 4, 6, and 13 years, $690,000, $730,000, and $940,000. The present worth net cost to the gov Alternative 4 assuming 3 years of monitoring in Target Area 1 following

assumed monitoring by the RTDF is $50,000. Thus, Alternative 4 has the worth cost.

State Acceptance

The State of Delaware concurs with the selected interim remedy for

Community Acceptance

The only comments received during the public comment period were f RTDF expressing support for the proposed remedy. No community oppositio proposed remedy was noted.

CONCLUSION

Based on the evaluation of the alternatives using the nine criteri (bioremediation) is preferred. Alternative 4 is protective of human hea environment, complies with all ARARs, represents a permanent remedy that re groundwater toxicity, provides the greatest ease of implementation, and is effective action alternative.

The selected alternative utilizes permanent solutions and alternat technologies to the maximum extent practicable. This interim action wil impact the ability to implement a final action, if it is required. The selected in the final Base-wide ROD.

Actual or threatened releases of hazardous substances from this Si addressed by the selected alternative, may present a current or potentia health, welfare, or the environment.

GLOSSARY AND ACRONYMS

Air Sparinging - Underground injection of air into saturated soil and groun
in the in situ air stripping of volatile constituents.

Air Stripping - Transfer of volatile constituents from water to air by i
between air and water streams.

Aquifer - A geologic formation capable of yielding water to wells and sp

ARARs - Applicable or Relevant and Appropriate Requirements. Criteria s
federal and state statute and regulations that must be considered
of remedial alternatives.

Biodegradation - The breakdown of organic constituents by microorganisms in
complex compounds.

Capital Cost - Cost incurred for the construction and startup of a facil

CERCLA - Comprehensive Environmental Response, Compensation, and Liabili
Federal law creating the Superfund program.

Dense Non-Aqueous Phase Liquid (DNAPL) - An organic liquid with a low wa
solubility and a density greater than that of water. DNAPLs retai
and chemical properties when in contact with water and tend to sin
when released to groundwater.

Density-Driven Convection - Modified in-ground air sparging system which
flow pattern in the vicinity of the sparging well.

EPA - U.S. Environmental Protection Agency.

Ex Situ - Performed above ground.

FS - Feasibility Study. Study undertaken to evaluate remedial alternati

FFS - Focused Feasibility Study.

Groundwater - Subsurface water residing in a zone of saturation.

Target Area 1

GLOSSARY AND ACRONYMS (cont'd)

HQ - Hazard Quoitient. An indicator of the noncarcinogenic health risk exposure to a chemical.

In Situ - In the original location (in ground for this report).

IRP - The U.S. Air Force Installation Restoration Program.

Leach - The solubilization and transport of constituents in soil through th surface water to groundwater.

LECR - Lifetime Excess Cancer Risk. The probability of the carcinogenic he associated with exposure to the chemicals of concern.

O&M Cost - Annual cost incurred for operation and maintenance of a facility

Maximum Contaminant Levels (MCLs) - Federal drinking water standards.

Plume - A recognizable distribution of constituents in groundwater.

Potentiometric Surface - An imaginary surface that represents the static he groundwater and is defined by the level to which water will rise.

RBSC - Risk Based Screening Concentration. A chemical-specific concentrati preliminarily assess whether exposure to a chemical poses a potential

RAO - Remedial Action Objective. Cleanup goal established for the remediat

RCRA - Resource Conservation and Recovery Act.

ROD - Record of Decision. A legal document issued by the lead governmental
selecting the remedy to be implemented at a CERCLA site.

RTDF - Remediation Technologies Development Forum.

Soil Vapor Extraction (SVE) - An in situ physical treatment process to vola
withdraw VOCs from subsurface soil residing above the groundwater tab

Vadose Zone - Soil zone above the water table.

VOCs - Volatile organic compounds.

Target Area 1